The influence of connectivity and dimensionality in the morphology of chimera states

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We study the morphology of chimera states using the Leaky Integrate-and-Fire (LIF) and the FitzHugh Nagumo (FHN) models in 1D, 2D and 3D spatial dimensions. Using both models, we show numerically that the coherent and incoherent domains which are formed in 1D ring geometry give rise to (coherent and incoherent) disks, stripes and spiral chimeras, when 2D toroidal geometry is employed. Similarly, the generalization to 3D hypertorus geometry gives rise to (coherent and incoherent) spheres, cylinders and layered chimeras. When non-trivial connectivity schemes are considered, such as diagonal, reflecting or fractal connectivities, complex chimeras arise, such as solitary states, two-level chimeras and coexistence of chimeras and subthreshold oscillations. Applications to brain dynamics using spatial MRI and functional EEG connectivity matrices are discussed.

References

[1] I. Omelchenko, A. Provata, J. Hizanidis, E. Schöll, and P. Hövel, "Robustness of chimera states for coupled FitzHugh-Nagumo oscillators" *Phys. Rev. E* **91**, 022917 (2015).

[2] A. Schmidt, T. Kasimatis, J. Hizanidis, A. Provata, and P. Hövel, "Chimera patterns in two-dimensional networks of coupled neurons", *Phys. Rev. E* **95**, 032224 (2017).

[3] G. Argyropoulos and A. Provata, "Chimera states with 2D deterministic and random fractal connectivity" *Frontiers in Applied Mathematics and Statistics* **5**, 35 (2019).